

REVISION OF SECTION SUFFRUTICOSI OF THE GENUS *SENECIO* (COMPOSITAE)¹

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This study includes the extra-tropical North American species of *Senecio* which are suffruticose perennials; glabrous to woolly tomentose; with several to many stems arising from a tap-rooted woody caudex; with leaves simple, linear to linear-filiform, or pinnately divided into linear or linear-filiform segments. These plants are believed to constitute a natural assemblage of species and are here termed the *Suffruticosi*.

Present use of the term *Suffruticosi* approximates that given formal taxonomic status by Greenman (1901) and called section *Longilobi* by Rydberg (1917). It is used here, however, purely as a convenience and does not imply formal taxonomic acceptance. The whole complex of ligneous and subligneous *Senecios* must receive critical attention before the sectional lines are formally defined.

A total of seventeen species were recognized by Greenman in his treatment (1901). Of these, only the following five are included in the present study: *S. douglasii* DC., *S. filicifolius* Greenm., *S. filifolius* Nutt., *S. multicapitatus* Greenm., and *S. spartioides* Torr. & Gray. Other species which have been included in the *Suffruticosi* at one time or another due to the ligneous condition of their stem, but have not been included in the present study are: *S. alvarezensis* Greenm., *S. calcarius* HBK., *S. carnerensis* Greenm., *S. cedrosensis* Greene, *S. chrysactis* Schultz Bip., *S. cinerarioides* HBK., *S. flaccidus* Less., *S. lemmoni* A. Gray, *S. lyonii* A. Gray, *S. marietanus* DC., *S. peninsularis* Vasey & Rose, *S. picridis* Schauer, *S. procumbens* HBK., *S. stoechadiiformis* DC., and *S. teliformis* Greenm. Most of these excluded species form a large complex in the Andes and the mountains of Central Mexico. Exceptions to this are *S. lyonii* and *S. cedrosensis* which occur on the islands off the coast of California and Baja California but do not appear to be a part of this natural assemblage.

Senecio lemmoni, although a temperate North American species, is morphologically so unlike the group that it also is excluded.

The *Suffruticosi* complex, as presently recognized, ranges throughout the

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Southwest, east from California through the Great Plains region to about the ninety-seventh meridian, and from near the Canadian border southward into Mexico.

Historical Account

The *Suffruticosi* complex was first treated by De Candolle (1837) and later by Gray (1884) in his Synoptical Flora of North America. Greenman (1901) listed the species he considered to belong to this group, but no complete study was directed solely toward them.

In undertaking this study it was hoped that much of the taxonomic confusion in this section could be eliminated. In attempting to identify initial collections it was noted that names often followed state boundaries instead of population boundaries. For example *S. douglasii* keys to *S. longilobus* in Colorado (Harrington, 1954), to *S. filifolius* in New Mexico (Wooton and Standley, 1915), and to *S. douglasii* in California (Abrams, 1960).

There is also disagreement as to the taxonomic rank to use for different entities. *Senecio riddellii* Torr. & Gray, for example, is treated as a species by some writers and as a variety by others.

A total of forty-nine names have been used for the *Suffruticosi* as here conceived. In this study only five species and two varieties are given taxonomic acceptance.

Characters of Taxonomic Significance

Pubescence. Plants in the *Suffruticosi* range in pubescence from glabrous to woolly tomentose. In three species lack of pubescence seems to be a stable character. *Senecio riddellii* was grown in the Kansas State University greenhouse as well as in an experimental plot at Manhattan, Kansas, and remained glabrous during its entire life cycle under these conditions. This was not true for *S. douglasii* (Figs. 1-4). Seeds from a woolly tomentose parent grew into plants showing varying degrees of pubescence.

Perennating Organs. A woody, erect caudex with a large taproot is the common condition found in this complex.

Leaves. The lobing patterns of the leaves offer taxonomic characters for separating *S. riddellii* and *S. multicapitatus* from *S. spartioides*. In *S. douglasii*, however, this character proves to be too variable for taxonomic significance. In collecting material in the field it was noticed that individuals would range from forms with entire leaves to forms with pinnatifid leaves with an integrading series of intermediate forms. For example, the collection Barkley, Ediger, & Lackey 380 has both entire and pinnatifid leaves. Some plants grown from seed of this collection have entire leaves, some have pinnatifid leaves, and some have a combination of both.

Another factor of some taxonomic importance in separating the two varieties of *S. douglasii* is the fascicles of leaves which often occur in the leaf axils of *S. douglasii* var. *longilobus*. These fascicles are short branchlets with whorls of smaller leaves growing in the axils of the primary leaves along the main stems of the plant.

Inflorescence. The inflorescence is composed of several to many heads arranged in a corymbose cyme. The number of involueral bracts present, although not constant, provides a significant character for separating taxa. As reported by Barkley (1960, 1962, 1968) in other groups of *Senecio*, the involueral bracts tend to be present in numbers corresponding to the Fibonacci series (1, 1, 2, 3, 5, 8, 13, 21).

Another significant feature is the calyculate involucre, and the length of these outer bracteoles compared to the length of the major involueral bracts.

Although the number of ray florets may be significant for taxonomic purposes, they are often missing from herbarium material and are frequently lost from maturing plants, so they are not a convenient character.

The color of the rays (yellow) and the canescent condition of the achenes do not show enough variation to be significant.

Habitat. The habitat in which this group of *Senecio* can be found is relatively uniform throughout its range. After several extended collecting trips and from data on specimens it is evident that these plants grow primarily in dry, sandy, or rocky, disturbed areas. Roadcuts and dry stream washes are the normal habitats.

The soil is generally gravelly or rocky and seldom will support much other vegetation within close proximity to a *Senecio* shrub. Along roadsides the plants will often be found on steep slopes or the shoulder gravel. If other vegetation invades, the *Senecio* soon disappears. In an experimental plot at Manhattan, Kansas, plants thrived as long as other vegetation was excluded. When the plot was allowed to return to its natural condition, the *Senecio* plants were soon choked out.

Biology of the Group

The chromosome numbers found in the *Suffruticosi* follow the pattern described by Afzelius (1925, 1949) and discussed by Barkley (1962). Table 1 is a list of the chromosome counts which are known from published accounts or from voucher collections which have been seen. The names of the voucher specimens are grouped under the entity to which they have been referred in the text of this paper.

In all cases counts of $n=20$ are reported. Therefore chromosome number is not of diagnostic importance in delimiting species in this group.

During the summer of 1965 seeds were collected from Oklahoma, New Mexico, Texas, and Arizona. In the fall these seeds were planted in the greenhouse. After the plants were large enough to handle they were individually potted. In the spring of 1966 duplicates of these plantings were transferred to an experimental plot below Tuttle Creek Dam, 6 miles north of Manhattan, Kansas. The plants were allowed to remain there for two years with comparisons made between those in the experimental plot, those left in the greenhouse, and the specimens of parental material from which the seeds were obtained.

Due to the semi-weedy nature of this group, taxonomic characters in several cases proved to be quite variable. One example of the range of variation

found to exist in these plants is shown in Figs. 1-4. In this instance seeds from a densely white-tomentose parent plant with mostly short entire leaves and numerous fascicles of leaves in the leaf axils produced both glabrous and tomentose plants. There was also extensive variation in the leaves, ranging from long entire leaves on some plants to pinnatifid leaves on other plants. There were also plants that lacked fascicles of leaves in the axils while other plants exhibited this condition. Plants from other collections grown under these conditions also produced extensive variation. Plantings of *S. riddellii*, however, retained their characteristic morphology under these experimental conditions.

Further experimental studies are required to significantly quantify the data and bring a more meaningful understanding to the apparently complex genealogy of the group.

Taxonomic Concepts

The species concept employed in this study is based on morphological variation and geographical distribution. Several species intergrade with each other at their boundaries, thus almost eliminating morphological gaps in variation which should theoretically exist for separation of taxa. Admittedly this is not a perfect concept of species, but to insist on complete separation by morphological gaps in variation would create a huge species complex, distinct in different regions of its range but held together by a few morphological intermediates.

Varieties are the only intraspecific taxa recognized in this study. They are based on less consistent morphological variation and on geographic distribution. This is in accord with the species concept used by Barkley (1960, 1962, 1968) for other similar behaving groups of *Senecio*.

Sources of Data

This revision is based on field work, herbarium studies, experimental studies, and the pertinent literature.

Over 5,000 herbarium specimens have been studied and annotated. Specimens were kindly lent by the following institutions: A, ARIZ, DS, F, GH, JEPS, KSC, MICH, MO, NY, PH, SMU, TEX, UC, US, UTC. The symbols used in the citations of specimens are in accord with the Lanjouw and Stafleu, *Index Herbariorum*, part I (1964).

Distribution Maps

The distribution maps were made by plotting the collection localities of the herbarium specimens brought together at Kansas State University for this study. In general one dot represents a single collection. In areas of repeated collecting, however, one dot represents several collections from the same locality.

The purpose of the distribution maps is to show graphically the distribution and geographical range of the different entities. Since certain areas are more accessible than others, a false representation as to areas of heavy concentration of certain taxa is evident.

Due to the poisonous nature of some species to livestock, they may be completely missing from areas which they formerly inhabited because of intentional eradication programs. This is especially true for *S. riddellii* which is currently rather rare in Kansas, although the distribution map would tend to indicate it to be abundant in the western half of the state. Most of these collections were made sixty or more years ago.

The numbers of the maps correspond to the numbers of the various taxa in the text.

KEY TO SPECIES

1. Plants subtomentose to woolly tomentose. 1. *S. douglasii*
1. Plants glabrous or with minute amounts of tomentum in the leaf axils and among the heads in the inflorescence.
 2. Heads calyculate with at least some bracteoles one-half the length of the involucre bracts. 1. *S. douglasii*
 2. Heads lacking bracteoles, or if bracteoles present, all less than a fourth the length of the involucre bracts.
 3. Heads small, narrowly campanulate or subcylindrical; disks 3-6 mm wide, rarely wider in pressed specimens; involucre bracts (7) 8 (13).
 4. Leaves mostly pinnately divided into narrowly linear-filiform segments seldom exceeding 1 mm in width. 2. *S. multicapitatus*
 4. Leaves mostly simple, linear with at least some 2 mm or more wide. 3. *S. spartioides*
 3. Heads large, campanulate; disks 7-12 mm wide in pressed specimens; number of involucre bracts (8) 13 (17).
 5. Leaves linear-pinnatifid; plants of the Great Plains and hills of central and south central United States. 4. *S. riddellii*
 5. Leaves linear-entire; plants of the central coastal area of California. 5. *S. blochmanae*

1. SENECIO DOUGLASII DC.

Suffruticose perennial 0.3 - 2.0 m tall, glabrous to white-tomentose; stems erect, several to many, branching from an almost herbaceous to a woody taprooted caudex. Leaves narrowly linear, few to numerous and extremely variable: all entire, all pinnatifid, or all stages in between, generally with a few lateral segments. Principal leaves of tomentose forms often with fascicles of somewhat smaller leaves, or short leafy branches in the axils of the lateral branches. Fascicles of leaves rare in glabrous forms to abundant in some tomentose specimens. Inflorescence terminating the stems in a corymbose cyme of several to numerous heads; heads campanulate (6) 8-12 (15) mm wide at the top of the involucre bracts tapering to (3) 4-6 (7) mm in width at the base of the involucre bracts; principal involucre bracts 13-21 in number (6) 7-10 (14) mm long, bracteoles few to many from less than a

fourth to three-fourths the length of the principal bracts; rays yellow; achenes canous-hirtellous.

Dry, sandy, rocky soils, creek bottoms, and disturbed areas throughout the dry valleys and plains of the southwestern U.S. and northern Mexico.

Senecio douglasii is the most diversified species in this group, having a great number of geographic and ecological variants, many of which have been given taxonomic recognition in the past. Several of these names correspond more closely to state lines than to population boundaries. Present breeding experiments indicate that a complete examination of phenotypic expression of this species would be most valuable.

Various phases of this species have been well known under the names *S. longilobus*, *S. monoensis*, *S. filifolius*, and in nomenclatural combinations of these names. Two varieties are recognized in the present study.

Key to Varieties of *Senecio douglasii*

1. Plants mostly glabrous or subtomentose, becoming tomentose in their southeastern range of the U.S. and Mexico; heads large, mostly 10 mm wide or wider; bracteoles conspicuous, some at least one-half the length of the involucre bracts or longer. . . . 1a. *S. douglasii* var. *douglasii*
1. Plants mostly white-tomentose, few being subtomentose; heads about 10 mm or less in width; bracteoles absent or few in number, less than one-half the length of the involucre bracts. . . . 1b. *S. douglasii* var. *longilobus*

1a. SENECEO DOUGLASII DC. var. DOUGLASII

Senecio douglasii DC., Prodr. 6:429. 1837. Type Coll.: Douglas, California, 1833. (GH — isotype)

Senecio monoensis Greene, Leaflets Bot. Obs. & Crit. 1906. *S. douglasii* var. *monoensis* (Greene) Jepson, Man. F. Pl. Calif. 1149. 1925. Type Coll.: Heller 8330, White Mountains of Mono Co., California, on slate hills near Southern Belle Mine, 25 May 1906. (US — holotype; DS, F, GH, MO, NY, PH, UC).

Senecio lathyroides Greene, Leaflets Bot. Obs. & Crit. 1909. Type Coll.: Jones 5077, Pierce's Spring, Arizona, 18 Apr 1894. (US — holotype; NY).

Senecio filicifolius Greenm., Ann. Mo. Bot. Gard. 1:274. 1914. Type Coll.: Pringle 316, Valley of the Santa Cruz River, 11 May 1881. (Reputedly at GH but not seen.)

Senecio pectinatus A. Nels., Univ. Wyoming Pub. Bot. 1:141. 1926. Type Coll.: Hanson 1020. In washes. Infrequent. Near Baboquivari Mts, Arizona, 24 Feb 1923. (Photograph & fragments US — holotype; F, MO, PH, US).

Senecio douglasii var. *tularensis* Munz, Aliso 4:99. 1958. Type Coll.: Munz 12222, Dry slopes of disintegrated granite under oaks, road from Springville to Camp Nelson. Sequoia National Forest, Tulare County, California, 12 Oct 1947. (NY — isotype).

Senecio warnockii Shinnars, Sida 1:379. 1964. Type Coll.: Turner & Warnock 202, Frequent on gypseous soil; 40 miles north of Van Horn, Texas, alt. 4000 ft., 16 Sep 1948. (SMU — holotype; MICH.)

Plants suffruticose to almost herbaceous, glabrous to subtomentose; leaves

few, mostly pinnatifid; heads large, mostly over 10 mm in width; bracteoles conspicuous, at least some over one-half the length of the involucre bracts.

Rocky or sandy soils on the slopes of mountains from near sea level to 5,500 feet. Ranging from the fortieth parallel in California south into Baja California and Sonora, Mexico. Also found in the southern tip of Nevada, southwestern corner of Utah, throughout Arizona with several collections in New Mexico and western Texas.

Representative material.² ARIZONA. Cochise Co.: *Ediger 535* (KSC). Coconino Co.: *Delzie Demaree 40955* (NY). Gila Co.: *Rose E. Collom 99* (GH, MICH, MO, NY, US). Graham Co.: *Maguire, Richards & Moeller 10164* (GH, US, UTC). Mohave Co.: *Gould & Darrow 4299* (ARIZ, GH, NY, UC). Pima Co.: *Frank W. Gould 3063* (ARIZ, DS, F, GH, MO, NY, UC, US, UTC). Yavapai Co.: *Barkley & Burroughs 288* (KSC). CALIFORNIA. Fresno Co.: *H. M. Hall 10035* (DS, MO, UC, US). Inyo Co.: *Victor Duran 598* (ARIZ, DS, F, GH, MICH, MO, NY, UC, US, UTC). Kern Co.: *Ediger 527* (KSC) and *528* (KSC). Los Angeles Co.: *Barkley & Burroughs 293* (KSC). Mendocino-Sonoma Co. line: *Barkley & Burroughs 302* (KSC). Monterey Co.: *Wiggins & Ferris 9012* (DS, GH, NY, UC, UTC). Riverside Co.: *Ediger 531* (KSC). San Bernardino Co.: *Leroy Abrams 2690* (DS, F, GH, MO, NY, PH). San Diego Co.: *Ediger 533* (KSC). San Luis Obispo Co.: *Ediger 529* (KSC). Santa Barbara Co.: *Ediger 530* (KSC). NEVADA. Clark Co.: *I. W. Clokey 8181* (ARIZ, DS, F, KSC, MICH, MO, NY, PH, SMU, TEX, UC, UTC). NEW MEXICO. Grant Co.: *John W. Gillespie 5317* (DS, GH, UC, US). Guadalupe Co.: *Aven Nelson 11321* (DS, GH, NY). Sierra Co.: *O. B. Metcalfe 971* (GH, MO, NY, PH, UC, US). UTAH. Washington Co.: *Frank W. Gould 1787* (ARIZ, DS, F, GH, NY, PH, UC, US).—MEXICO. BAJA CALIFORNIA: *Wiggins & Gillespie 4162* (DS, MICH, MO, NY, US). SONORA: *Roxana S. Ferris 8767* (DS, MICH, NY, US).

Senecio douglasii var. *douglasii* encompasses several different phases. Plants east of the Sierra Nevada Mountains in the White, Inyo, and Panamint mountain ranges of California and south into Baja California and Sonora, Mexico, are glabrous and appear more herbaceous than the other phases. Plants from these locations often die completely back to the ground each year. The glabrous phase also occurs on the east side of the Spring Mountains in Clark County, Nevada, the south-western corner of Utah, and in the mountainous areas of central Arizona, mainly in a zone running from the northwest corner to the southeast corner of the state. There have also been a few scattered collections in New Mexico and Texas. This phase has been treated as a distinct entity under the name *S. monoensis* Greene, and as a variety of *S. douglasii* DC. by Jepson (1925). Figure 6 illustrates the general morphology of this phase.

A second phase of this variety occurs west of the Sierra Nevada Mountains and along the coast south of San Francisco in California. In contrast to the first phase, the second phase exhibits a subtomentose condition, the tomen-

² A complete list of annotated specimens and an index to exsiccatae are in the dissertation on file at the Kansas State University Library.

tum increasing markedly toward the eastern limits of the range. The foliage is usually denser and may contain fascicles of smaller leaves in the primary leaf axils. The subtomentose plants also tend to be more woody.

The range for the subtomentose phase spreads eastward through Arizona becoming less common in New Mexico and Texas with only a few collections in Mexico and one in Utah.

Although the glabrous and subtomentose phases are represented by highly distinctive specimens, a complete series of intermediates exists between these forms and these phases lack any distinctive populational integrity of their own. Therefore, it is better to regard them as a single variable group than to attempt to separate them on superficial characters which do not remain constant under experimental conditions and which lack populational constancy in the field.

Most of the names which have been applied to this taxon represent extremes in variability. After examining a large number of collections and with the results of experimental material grown in the greenhouse presented in "Biology of the Group" I am convinced that the interpretation offered here is the most logical for the group.

Senecio warnockii Shinnery is described as being closely allied with *S. spartioides* on the basis of its entire leaves. However, its affinity seems to lie with *S. douglasii* with intermediates grading into the more typical forms of *S. douglasii*. It is probably an ecological phase restricted to gypseous soil.

In visiting with the operator of the Trading Post at Tsegi, Arizona, it was learned that *S. douglasii* has some importance in Navajo medicine and folklore.

1b. *SENECIO DOUGLASII* var. *LONGILOBUS* (Benth.) L. Benson, Amer. Journ. Bot. 30: 631. 1943.

Senecio filifolius var. *jamesii* T. & G., Fl. N. Am. 2: 444. 1843. (This was var. alpha, and *S. filifolius* Nutt. was given as synonym under this variety only. Hence the type is not the James collection used to amplify the description, but the type of *S. filifolius* Nutt. The epithet *jamesii* is therefore illegitimate under Art. 24 of the Code, since it includes the type of the next higher taxon.)

Senecio regiomontanus DC., Prodr. 6: 429. 1837. Type coll.: Mexico, circa Real del Monte, *Haenke* (not seen).

Senecio longilobus Benth., Pl. Hartw. 18. Type coll.: In arvis arenosis, Aguas Calientes, *Coulter 127* (not seen).

Senecio filifolius Nutt., Trans. Amer. Phil. Soc. n.s. 7: 414. 1841. Type coll.: banks of the Missouri towards the Rocky Mountains, *Nuttall* (photograph MO).

Senecio orthophyllus Greene, Leaf. Bot. Obs. & Crit. 1: 221. 1906. Type coll.: Willow Springs, Arizona, *Palmer 479*, in 1890 (US — holotype; photograph MO).

Plants suffruticose, tomentose; leaves few to many, entire to pinnatifid, often with fascicles of somewhat smaller leaves or short leafy branches in

the axils; heads mostly 10 mm. or less in width; bracteoles absent or few in number, less than $\frac{1}{2}$ the length of the involueral bracts.

Throughout New Mexico and western Texas, with fewer collections from the panhandle of Oklahoma, southern Colorado, southern Utah, northern and eastern Arizona, and above the 20th Parallel in Mexico.

Representative material. ARIZONA. Apache Co.: *Ediger 513* (KSC). Coconino Co.: *Leslie N. Goodding 2252* (DS, GH, MO, NY, UC). Coconino Co.: *Ediger 520* (KSC). Navajo Co.: *Ediger 518* (KSC). Pima Co.: *Ediger 534* (KSC). Yavapai Co.: *Ediger 526* (KSC). COLORADO. Fremont Co.: *Ediger 504* (KSC). LaPlata Co.: *Ediger 506* (KSC). Pueblo Co.: *Ediger 502* (KSC). NEW MEXICO. Bernalillo Co.: *A. A. Heller 15798* (DS, MO, NY, PH, US, UTC). Catron Co.: *Barkley, Ediger & Lackey 375* (KSC). Chaves Co.: *Ediger 539* (KSC). Dona Ana Co.: *E. O. Wooton, May 1905* (ARIZ, DS, MICH, MO, PH, US). Lincoln Co.: *Barkley, Ediger & Lackey 364* (KSC). San Juan Co.: *Ediger 507* (KSC). San Miguel Co.: *Paul C. Standley 4993* (GH, MO, NY, US). Taos Co.: *Barkley, Ediger & Lackey 357* (KSC). OKLAHOMA. Cimarron Co.: *Delzie Demaree 13367* (NY, SMU). TEXAS. Crane Co.: *Jim Lackey 3* (KSC). El Paso Co.: *Ediger 536* (KSC). Jeff Davis Co.: *Ferris & Duncan 2717* (DS, MO, NY). Lubbock Co.: *Demaree 7602* (DS, GH, MO, SMU, US). Pecos Co.: *Barton H. Warnock 46141* (F, MO, TEX). UTAH. Iron Co.: *Loran C. Anderson 900* (KSC). San Juan Co.: *Cronquist & Holmgren 9380* (NY, SMU, TEX, UTC). Wayne Co.: *Marcus E. Jones 5703* (MO, NY, UC, US).—MEXICO. CHIHUAHUA: *J. M. Tucker 2477* (ARIZ, DS, UC, US). COAHUILA: *Wynd & Mueller 421* (ARIZ, MICH, MO, NY). San Luis Potosi: *J. G. Schaffner 713* (MICH, NY, US).

The gross morphology and distribution of *S. douglasii* var. *longilobus* combine to make it a distinct entity. The morphology of the heads is similar to that of *S. douglasii* var. *douglasii* except for shorter or absent bracteoles and the smaller head size. *Senecio douglasii* var. *longilobus* is subtomentose or tomentose and more eastern in its distribution. The transition zone from typical *S. douglasii* var. *douglasii* to *S. douglasii* var. *longilobus* is centered in Arizona and Sonora, Mexico, where morphological intermediates make it difficult to separate the two varieties.

The decision to group so many variants into one species with only two varieties was strengthened by the experimental plantings carried out at Kansas State University from 1965-1967. The details of this experimental study are presented above.

2. SENECIO MULTICAPITATUS Greenm.

Senecio multicapitatus Greenm., Bull. Torrey Bot. Club 33:160. 1906. Type Coll.: *Vreeland 651*, Huerfano Valley near Gardner, Colo., 1900. (NY — lectotype).

Suffruticose perennial 30-130 cm tall, glabrous; stems several to many branching from a stout, woody, erect, taprooted caudex. Leaves irregularly pinnately divided into linear-filiform segments 1-2 (5) mm wide and (4) 5-7 (10)cm long, the lower leaves sometimes wider and with only small lobes,

grading into entire leaves without lobes. Inflorescence a terminal corymbose cyme of many heads; heads sub-cylindrical to narrowly campanulate, 2 mm wide at the base of the involucre bracts, spreading to 3-5 mm wide at the top of the involucre bracts in dried specimens. In nature the heads are often quite turbinate or even narrowing upwards. Principal bracts approximately 8 in number, 7-9 mm long, bracteoles, if present, few in number and less than a fourth as long as the principal bracts; rays yellow, usually persisting at maturity. Achenes canous-hirtellous.

Sandy, dry soils especially in old washes and hillsides at elevations of 5,000 to 9,000 feet. From the eastern edge of the Rocky Mountains westward throughout the middle elevations in Colorado, New Mexico, Arizona, and southern Utah. Apparently occasional in the mountainous areas of western Texas and Mexico, south of New Mexico.

Representative material. ARIZONA. Coconino Co.: *Gould & Phillips* 4762 (ARIZ, TEX, UC). Navajo Co.: *H. H. Rusby* 667 (MICH, NY). COLORADO. Alamosa Co.: *U. T. Waterfall* 12198 (TEX). Costilla Co.: *Anderson & Barkley* 2468 (KSC, NY). El Paso Co.: *J. H. Ehlers* 7938 (ARIZ, MICH). Montrose Co.: *Edwin Payson* 607 (DS, F, GH, MO). Rio Grande Co.: *Anderson & Barkley* 2525 (KSC). NEW MEXICO. Colfax Co.: *Rose & Fitch* 17544 (MO, NY, US). Dona Ana Co.: *E. O. Wooton* Oct. 20, 1903 (ARIZ, MICH, MO, NY, UC). Lincoln Co.: *F. S. & Esther Earle* 388 (MO, NY, US). San Miguel Co.: *Drouet & Richards* 3190 (F, MICH, MO, NY). Santa Fe Co.: *Rose & Fitch* 17690 (MO, NY, US). Taos Co.: *Barkley, Ediger & Lackey* 355 (KSC). TEXAS. Brewster Co.: *Omer E. Sperry* T652 (ARIZ, GH, UC). UTAH. Garfield Co.: *C. D. Marsh* 14089 (US). San Juan Co.: *H. C. Cutler* 3084 (DS, F, MO, NY, SMU). Uintah Co.: *Edward H. Graham* 7455 (UC).—MEXICO. CHIHUAHUA: *Harde LeSueur* 332 (ARIZ, F, UC).

Senecio multicapitatus is characterized by its glabrous condition, pinnately branched leaves, and its many small heads. *Senecio multicapitatus* is distinct within its own range but intergrades with *S. riddellii* at the eastern edge of the Rocky Mountains as is discussed under *S. riddellii*, and with *S. spartioides* as is discussed under that taxon.

A voucher for studies on the Navajo Indians by Washington Matthews (UC) lists the Indian name for this species as *gos bel Se hi*.

The type collection is a mixed complex of specimens from several states. To facilitate handling of nomenclature I have designated the specimen *F. K. Vreeland* 651 (NY) as the lectotype.

3. SENECIO SPARTIOIDES Torr. & Gray

Senecio spartioides Torr. & Gray, Fl. N. Amer. 2:438. 1842. Type Coll.: *Lieut. Fremont*, Sand-bank of the Sweetwater River (Wyoming), Aug.-Sept. (NY — holotype; GH).

Senecio serra var. *sanctus* Hall, Univ. Calif. Pub. Bot. 3:230. 1907. Type Coll.: *Hall* 7610, South Fork Santa Ana River, San Bernardino Mts., Calif., Along the lower edge of the Canadian Zone at 2000 M alt., 1 Aug 1906. (UC — holotype).

Senecio andersonii Clokey, Bull. S. Calif. Acad. Sci. 37:10. 1938. Type Coll.: Clokey & Anderson 5638, Lee Canyon in the yellow pine belt at an elevation of 2,550 M Nevada, 5 Aug 1935. (UC — holotype; ARIZ, DS, F, JEPS, MICH, MO, NY, TEX, UC, US).

S. spartioides var. *granularis* Maguire & Holmgren ex Cronquist in Ferris. Contrib. Dudley Herb. 5:102. 1958. Type Coll.: Maguire & Holmgren 26066, Head of Crooked Creek, White Mountains, Mono County, Calif. (NY — holotype; US, UTC).

Suffruticose perennial, 20-80 cm tall, glabrous; stems erect, numerous, branching from an erect taprooted caudex. Leaves narrowly linear and entire, rarely having a pair of short lobes at the base, usually at least a few over 1 mm wide, (3) 5-10 (12) cm long, evenly distributed up the stem. Inflorescence a corymbose cyme of many heads; heads subcylindrical to narrowly campanulate mostly 2 mm at the base of the involucral bracts spreading to (3) 4-6 (10) mm at the top of the involucral bracts. Principal bracts (7) 8-12 (13) in number and (3) 6-9 (10) mm long; bracteoles, if present, few in number and less than a fourth as long as the principal bracts; rays yellow; achenes canous-hirtellous.

Dry, sandy hillsides, plains, and disturbed areas mostly above 6,000 feet and up to 10,000 feet in the mountains of Colorado, Utah, southern Nevada, eastern and southern California, and the northern half of Arizona. Less frequent in New Mexico, Wyoming, and the extreme western edge of Nebraska and South Dakota. A few collections are from Baja California, but its distribution there is yet poorly known.

Representative material. ARIZONA. Coconino Co.: D. T. MacDougal 352 (ARIZ, F, GH, NY, PH, UC, US). Mohave Co.: Kearney & Peebles 12685 (ARIZ, F). Navajo Co.: H. H. Rusby 670 (F, NY, PH, UC). CALIFORNIA. Inyo Co.: Ross & Ross 5990 (DS, NY, UC). Mono Co.: J. T. Howell 27462 (DS, SMU, UC, US). COLORADO. Boulder Co.: Ewan & Ewan 26 Sept. 1937 (ARIZ, DS, F, GH, MICH, MO, NY, PH, SMU, TEX, UC, US, UTC). Chaffee Co.: I. W. Clokey 3496 (DS, F, GH, MICH, MO, NY, TEX, UC, US). Clear Creek Co.: H. N. Patterson 240 (F, GH, MICH, MO, NY, PH, UC, US). El Paso Co.: J. H. Ehlers 7937 (MICH, UTC). Gunnison Co.: Barkley, Ediger & Lackey 395 (KSC). Larimer Co.: Otto Degener 1504 (NY). Weld Co.: E. L. Johnston 328b (GH, NY). NEVADA. Clark Co.: I. W. Clokey 7411 (DS, NY, UC). Lyon Co.: Alexander & Kellogg 5317 (ARIZ, DS, SMU, UC, UTC). NEW MEXICO. Rio Arriba Co.: C. F. Baker 715 (F, GH, MO, NY, US). UTAH. Garfield Co.: Holmgren, Reveal & LaFrance 2463 (NY, TEX). Kane Co.: Loran C. Anderson 916 (NY, UTC). Washington Co.: Bassett Maguire 13940 (UTC). WYOMING. Albany Co.: Aven Nelson 9556 (GH, MICH, MO, NY, US, UTC). Laramie Co.: Aven Nelson 2726 (F, KSC).—MEXICO. Baja CALIFORNIA: Wiggins & Demaree 4953 (DS, F, NY, UC, US).

Senecio spartioides is very closely related to *S. multicapitatus*, with the entire leaves of *S. spartioides* being the primary morphological difference separating the two. *Senecio spartioides* is more abundant in the southern and

eastern extent of its range. Although plants of both species can be found at elevations of 5,000—10,000 feet, *S. spartioides* is more frequent above 7,000 feet than is *S. multicapitatus*.

Senecio spartioides, *S. multicapitatus*, and *S. riddellii* intergrade at the eastern edge of the Rocky Mountains in Colorado producing putative hybrids which are extremely difficult to place since the characteristics of all three species may occur in a single specimen.

In the New York Botanical Garden are specimens labeled as hybrids between *S. spartioides* and *S. eremophilous* var. *kingii* (Rydb) Greenm. This collection is Holmgren, Reveal & LaFrance 2463 from the Dixie National Forest of Utah, 14 Aug 1965. The ranges of these two populations overlap and hybridization is a distinct possibility, however the disparate placement of these two species in *Senecio* (Greenman, 1901) suggests that this would be a most noteworthy hybrid, warranting experimental investigation.

4. SENECIO RIDDELLII Torr. & Gray

Senecio riddellii Torr. & Gray, Fl. N. Amer. 2:444. 1843. *S. spartioides* var. *riddellii* (T. & G.) Greenm. Monogr. nord— & centralam. Art. Gattung *Senecio* pt. 1, 26. 1901. (Engl. Bot. Jahrb. 32:22. 1902). Type Coll.: Dr. Riddell, Texas. (Type reputedly at NY, not seen. Photograph MO, probable isotype US).

Senecio filifolius var. *fremontii* Torr. & Gray, Fl. N. Am. 2:444. 1843. *S. fremontii* Rydb., in Britton. Man. Fl. N. U.S. 1028. 1907. (not *S. fremontii* Torr. & Gray). Type Coll.: Lieut. Fremont, on the lower Platte, near the "chimney" Aug. - Sept. (NY — holotype; GH).

Senecio kuntzei Rydb., Fl. Rocky Mtns. & Adj. Plains. 990. 1917. Not *S. kuntzei* O. Hoffm. in Ktze., Rev. Gen. 3 (2):175. 1898. Type Coll.: Kuntze 3033, Colorado, Sept. 1874. (not seen).

Senecio spartioides var. *fremontii* Greenm. ex L. O. Williams, Ann. Mo. Bot. Gard. 23:456. 1936. Type Coll.: Williams, Sandy hills near Hat Creek, Niobrara Co., Wyoming, 6 Sep 1935. (MO — holotype).

Senecio riddellii var. *parksii* Cory, Rhodora, 45:164. 1943. *S. spartioides* var. *parksii* (Cory) Shinnars, Sida, 1:379. 1964. Type Coll.: Parks 27538, Flour Bluff, Texas, 18 Oct 1936. (GH — holotype; NY, SMU).

Suffruticose perennial 30-100 cm tall, glabrous; stems erect, several to many branching from a stout woody, tap-rooted caudex. Leaves irregularly pinnately divided into linear-filiform segments 1-5 mm wide and 4-9 cm long generally appearing flat, those on the lower part of the stem often drying and pendulous on mature plants, foliage generally quite heavy. Inflorescence a corymbose cyme of 5-20 heads; heads campanulate, (5) 7-10 (12) mm wide at the top of the involucre bracts, tapering to 2-4 (5) mm at the base of the involucre bracts in pressed specimens; principal involucre bracts approximately 13 in number and 7-10 (12) mm in length, bracteoles less than a fourth as long as the principal bracts; rays yellow, often early deciduous; achenes canous-hirtellous.

Sandy soils, deposits along rivers or flood plains, and other sandy areas under dry conditions. Along the eastern edge of Wyoming, southwest corner of South Dakota, the Sand Hill region of Nebraska, eastern plains of Colorado to the Rocky Mountains, western half of Kansas, Oklahoma, and Texas. *Senecio riddellii* also occurs in the lower mountain ranges of New Mexico and central Arizona. A few collections are from northern Mexico.

Representative Material. ARIZONA. Navajo Co.: *Peebles & Fulton* 9609 (ARIZ, US). COLORADO. Denver Co.: *I. W. Clokey* 2945 (ARIZ, MO, NY, UC). Lincoln Co.: *Ivar Tidestrom* 664 (US). Washington Co.: *William A. Weaver* 12952 (NY). KANSAS. Barber Co.: *R. L. McGregor* 13762 (SMU, US). Clark Co.: *M. A. Carleton* 742 (GH, KSC, MO, US). Ellis Co.: *Elam Bartholomew* 1156 (NY). Hamilton Co.: *Rose & Fitch* 17015 (NY, US). Sheridan Co.: *Clement Weber* 158 (KSC). NEBRASKA. Cherry Co.: *W. L. Tolstead* 762 (GH). Grant Co.: *P. A. Rydberg* 1677 (GH, NY, US). Kimball Co.: *A. A. Heller* 14304 (DS, F, MO). NEW MEXICO. Bernalillo Co.: *Arsene & Benedict* 17511 (F, SMU, US). Chaves Co.: *U. T. Waterfall* 5709 (GH, MO, NY, SMU). Lincoln Co.: *Earle & Earle* 224 (MO, NY, UC, US). Santa Fe Co.: *Barkley, Ediger, & Lackey* 358 (KSC). OKLAHOMA. Cleveland Co.: *George J. Goodman* 2764 (GH, MO, NY, SMU, UC, US). Harmon Co.: *Lloyd H. Shinnors* 31655 (SMU). Texas Co.: *Lloyd C. Hulbert* 4188 (KSC). Woods Co.: *G. W. Stevens* 2826 (DS, GH, MO, NY, SMU, US). SOUTH DAKOTA. Custer Co.: *Jones & Jones* 14473 (F). Shannon Co.: *S. S. Visher* 2208 (F, NY). TEXAS. Brewster Co.: *B. H. Warnock* 46672 (SMU, TEX). Jeff Davis Co.: *Loran C. Anderson* 3036 (KSC). Lipscomb Co.: *Charles S. Wallis* 7958 (SMU, TEX). Mustang Island: *Fred B. Jones* 665 (SMU). Presidio Co.: *B. H. Warnock* T169 (ARIZ, GH, TEX, US). WYOMING. Goshen Co.: *Porter & Porter* 1948 (DS, US). Weston Co.: *Mildred E. Mathias* 298 (GH, MO).

Senecio riddellii is characterized by its glabrous condition, pinnately divided leaves, and large heads. It is also the most easterly ranging species of this entire group.

Senecio riddellii is distinct within its own range but intergrades with *S. spartioides* and *S. multicapitatus* at the eastern edge of the Rocky Mountains, and in Arizona and New Mexico. This is illustrated by some of the basal leaves of *S. riddellii* becoming entire where the populations come together. The details and extent of this intergradation are yet to be elucidated.

Collections from Padre and Mustang Islands of Texas, along the Gulf of Mexico, show increased leaf width and greater head size than most of the other collections (Fig. 10). Representative collections of this population are *V. L. Cory* 36658-36660 (GH). Occasional specimens from other locations throughout the range also exhibit these characteristics. I have not done field work on these islands, but this condition may be environmentally induced. Further field work must be done before the proper disposition of these plants can be determined. Until such time it seems best to consider them merely as an extreme in the total range of variability of the species.

5. *SENECIO BLOCHMANAE* Greene

Senecio blochmanae Greene, *Erythea* 1:7. 1893. Type Coll.: Mrs. Blochman, Santa Maria River, San Luis Obispo Co., California, Nov. 1892. (UC — holotype; NY).

Suffruticose perennial 45-130 cm tall, glabrous; stems woody and numerous, arising from a thickened base and apparently not dying back each year. Leaves entire, linear-filiform, 3-11 cm long, 1(+) mm wide, the lower ones drying and pendulous on mature plants, foliage abundant. Inflorescence a corymbose cyme of 5-20 heads; heads campanulate 7-9 (12) mm wide at the top of the involucre bracts in pressed specimens; principal involucre bracts approximately 13 in number, 7-10 mm long, bracteoles, if present, very few in number and usually less than a fourth as long as the principal bracts. Rays yellow; achenes canous-hirtellous.

Sand dunes and flood plains near the coast in Santa Barbara and San Luis Obispo Counties, California.

Representative Material. CALIFORNIA. San Luis Obispo Co.: *Delzie Demaree 18092* (DS, MO, NY, US). Santa Barbara Co.: *Annetta Carter 1330* (DS, GH, MICH, MO, NY, SMU, TEX, US, UTC).

Senecio blochmanae is characterized by its glabrous condition, entire leaves, and restricted distribution. The many leaves along the stem are thickened at the base, giving the stem a scaly appearance. The stems become purple-striated in age, often turning entirely purple, especially below.

Senecio blochmanae is distinct within its range and collections do not suggest any intergradation with any other *Senecio*.

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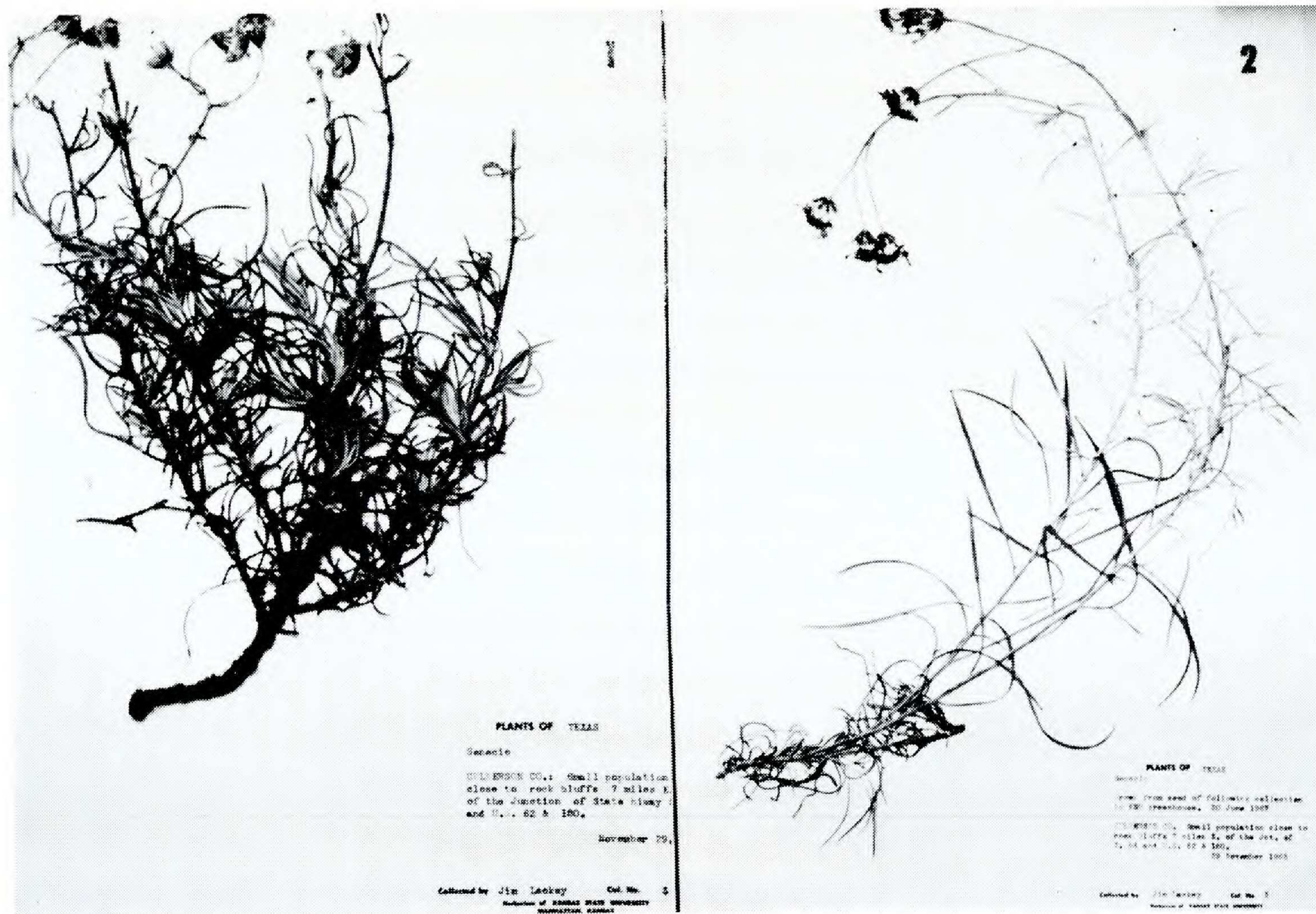
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Figs. 1—4. Voucher specimens for experimental growth studies of *Senecio douglasii*. Fig. 1. Parent plant, Jim Lackey 3, from which seeds were collected for greenhouse plantings. Fig. 2. Specimen grown in the greenhouse from the above-mentioned plant, showing both long entire and small pinnately divided leaves.



Figs 1—4. Voucher specimens for experimental growth studies of *Senecio douglasii*. Fig. 3. Specimen grown from same parent plant as 2, having all pinnately divided leaves. Fig. 4. Plant from seed of the same parent plant as 2 and 3 but transferred to an experimental plot at Tuttle Creek Dam after one year in greenhouse. This specimen had several branches which were glabrous and others which were woolly-tomentose.

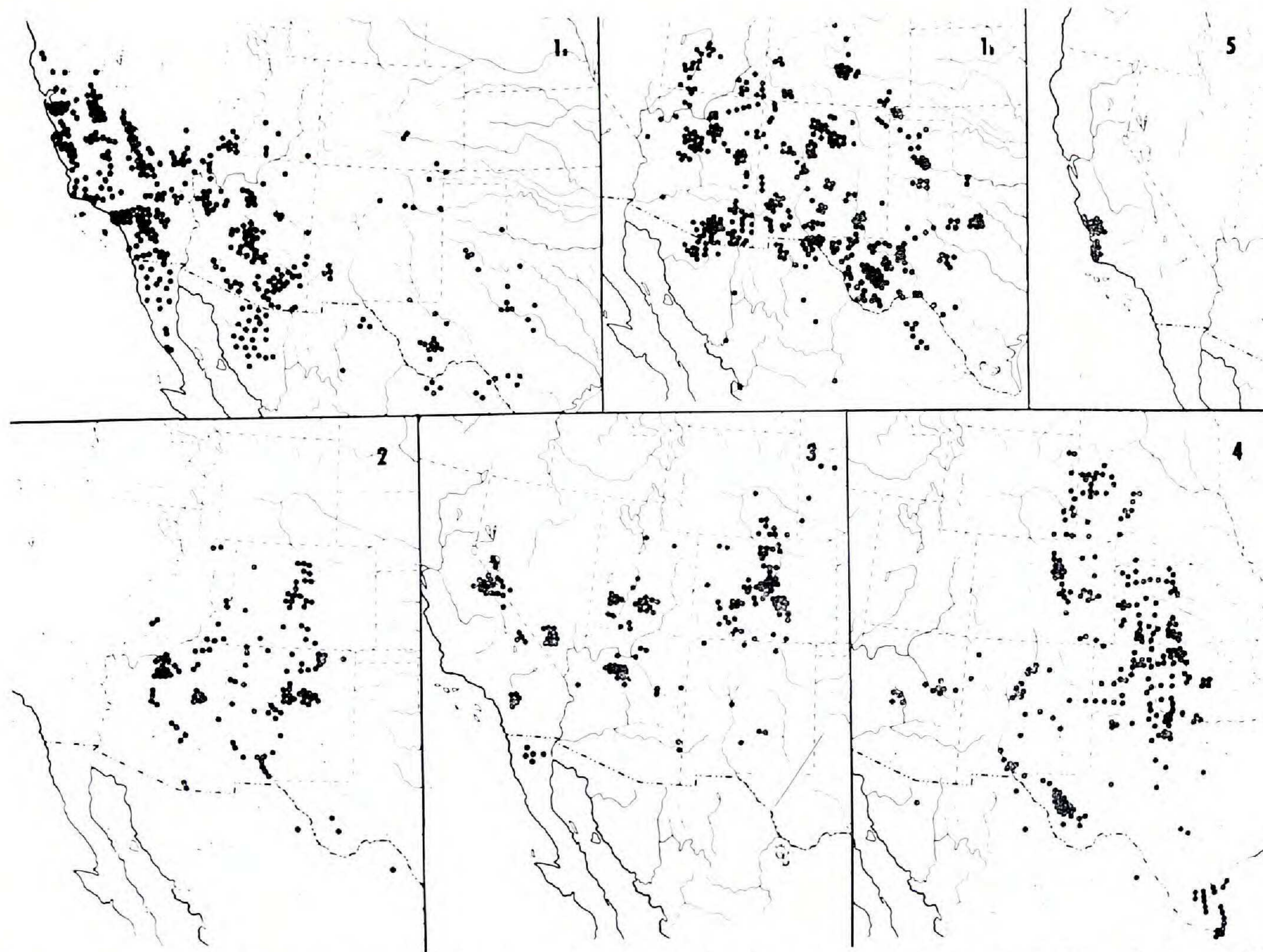
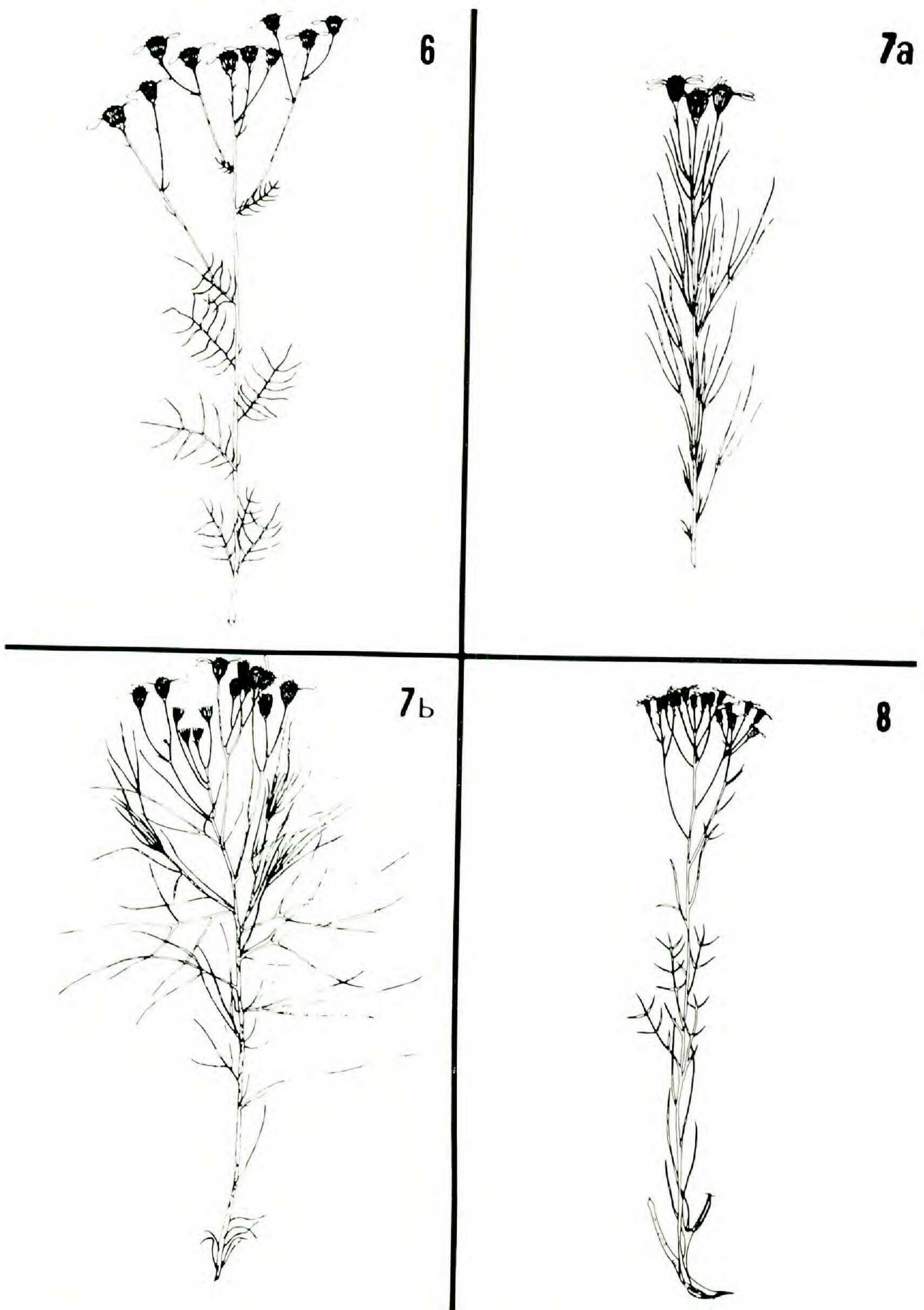
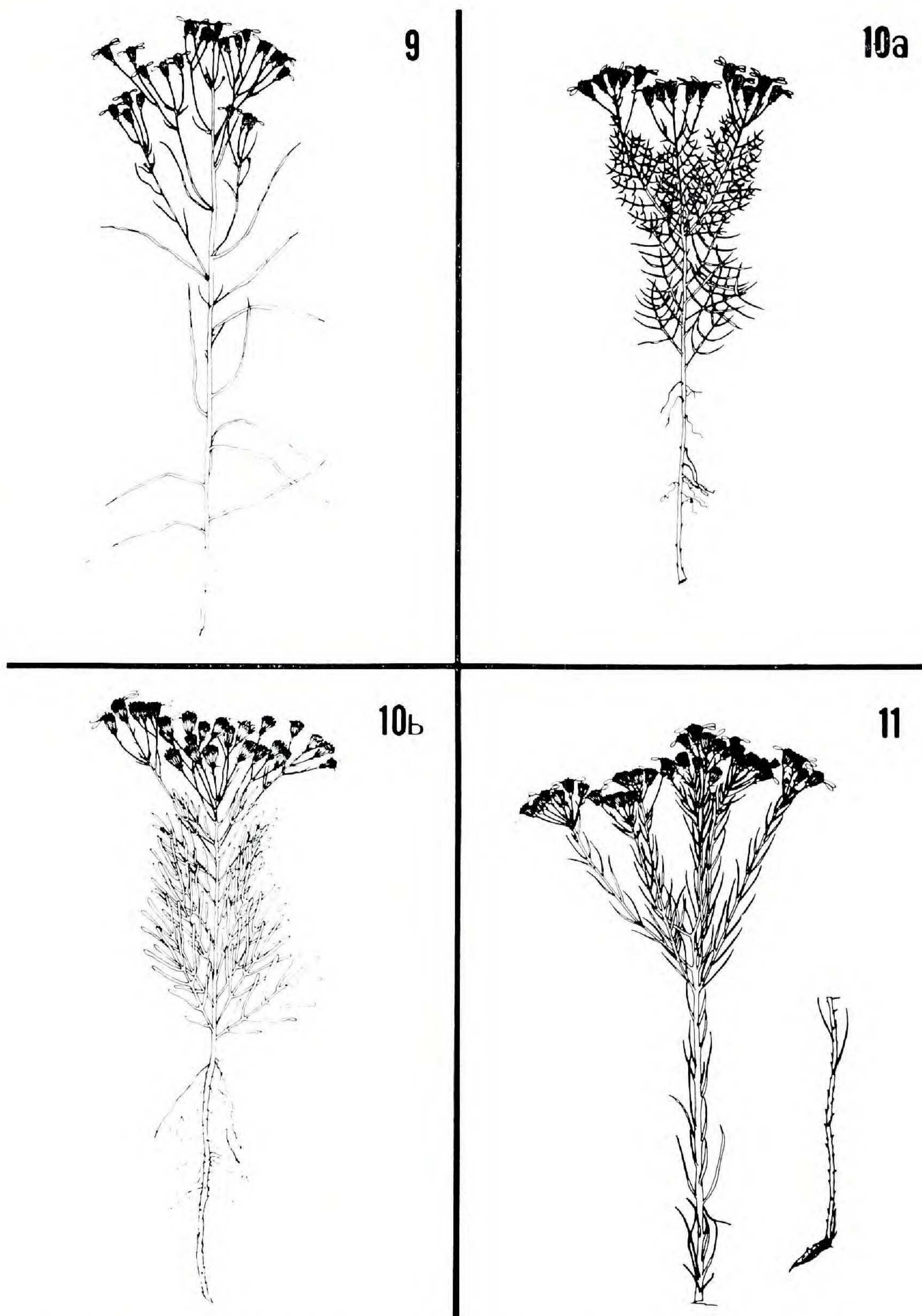


Fig. 5. Distribution of: 1a. *Senecio douglasii* var. *douglasii*, 1b. *S. douglasii* var. *longilobus*. 2. *S. multicapitatus*. 3. *S. spartioides*. 4. *S. riddellii*. 5. *S. blochmanae*.



Figs. 6—8. Illustrations of: 6. *Senecio douglasii* var. *douglasii*. 7. *S. douglasii* var. *longilobus*, (a) woolly-tomentose plant with fascicles of leaves in many of the primary leaf axils, (b) a tomentose plant with fewer fascicles in the axils of the longer primary leaves. 8. *S. multicapitatus*.



Figs. 9—11. Illustrations of: 9. *Senecio spartioides*. 10. *S. riddellii*, (a) typical form, (b) form with greater head size and broader leaf divisions characteristic of collections from Padre and Mustang Islands, Texas. 11. *S. blochmanae*.

TABLE 1. CHROMOSOME COUNTS

<i>Name</i>	<i>Gametic Chromosome #</i>	<i>Location</i>	<i>Collector</i>	<i>Publication</i>
<i>S. blochmanae</i>	20	Santa Barbara Co., Calif.	Raven 15503	Ornduff et al. 1963
<i>S. douglasii</i> DC.	20	Riverside Co., Calif.	Kyhos 58-189	Ornduff et al. 1963
<i>S. douglasii</i> DC.	20	Los Angeles Co., Calif.	Mosquin C-19	Ornduff et al. 1963
<i>S. douglasii</i> DC.	20	Riverside Co., Calif.	Lewis 1249	Ornduff et al. 1963
<i>S. douglasii</i> DC.	20	Stanislaus Co., Calif.	Breedlove 4854	Ornduff et al. 1967
<i>S. douglasii</i> DC.	20	Ventura Co., Calif.	Breedlove 5576	Ornduff et al. 1967
<i>S. douglasii</i> var. <i>monoensis</i> (Greene) Jepson	20	Inyo Co., Calif.	Raven 12007	Ornduff et al. 1963
<i>S. monoensis</i> Greene	20	Yavapai Co., Arizona	Turner 4789	Powell 1963
<i>S. pectinatus</i> DC.	20	Mt. Kosciusko, Australia	Moore s.n.	Ornduff et al. 1963
<i>S. douglasii</i> var. <i>longilobus</i> (Benth.) L. Benson				
<i>S. longilobus</i> Benth.	20	Apache Co., New Mexico	Ornduff in 1957	Ornduff et al. 1967
<i>S. longilobus</i> Benth.	20	Rio Arriba Co., New Mexico	Mosquin 5744	Ornduff et al. 1967
<i>S. longilobus</i> Benth.	20	Jeff Davis Co., Texas	Mosquin 5658	Ornduff et al. 1967
<i>S. longilobus</i> Benth.	20	Bernalillo Co., New Mexico	Jackson 2037	Jackson 1959
<i>S. multicapitatus</i> Greenm.	20	Rio Arriba Co., New Mexico	Jackson 3119	—————
<i>S. spartioides</i> Torr. & Gray	20	San Bernardino Co., Calif.	Raven 11165	Ornduff et al. 1963
<i>S. spartioides</i> Torr. & Gray	20	Coconino Co., Arizona	Solbrig 2799	Ornduff et al. 1963